

**DEEP SOIL SAMPLING PLAN
LOWER YAKIMA VALLEY
GROUNDWATER MANAGEMENT AREA**

March 28, 2014

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LOWER YAKIMA VALLEY
GROUNDWATER MANAGEMENT AREA**

Prepared for:

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March 28, 2014

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1.0 INTRODUCTION

The GWMA project is a multi-agency, citizen-based, coordinated effort to reduce groundwater nitrate concentrations in the Lower Yakima Valley (LYV) to below Washington State drinking water standard. This project will identify activities contributing to nitrate groundwater contamination based on scientific data and evaluation.

Nitrate is added to soil by natural processes and human activities. Human activities include growing crops, and managing animal waste, human waste, and waste waters. Nitrate within the plant root zone may be utilized by the plants and if managed properly, leaching to groundwater can be minimized.

Nitrate in soil results primarily from land use at that location over time. Measuring deep soil nitrate may therefore help identify activities that contribute to nitrate groundwater contamination. Looking at nitrate concentrations in soil samples can provide relatively quick feedback on the effectiveness of changes to management practices designed to reduce groundwater contamination.

Initial deep soil sampling should be conducted for the purposes of:

- 1) Providing baseline data regarding the nitrogen content (nitrate, ammonium, and organic matter) of soils underlying a variety of soil, crop, and irrigation systems that represent a cross-section of agricultural activities.
- 2) Provide an initial assessment of current nitrogen and water management practices in place today and in the past.
- 3) Provide information regarding availability of soil nitrogen to crops.
- 4) Provide the foundation for a technically based education program.
- 5) Provide information about project design, practical realities, time requirements and costs that can be used in developing subsequent project scopes.

This deep soil sampling may not be sufficient to address future technical questions that may arise during the course of data collection and assessment conducted by current and future consultants tasked by the LYV GWMA Executive Committee (GWAC). Deep soil sampling will be conducted initially for two years to collect baseline information. Deep soil sampling may be repeated in future years to allow analysis of the effects of changing management practices. The timing and budget of future sampling will be coordinated with the pace of change in nitrogen application and irrigation water management practices, as determined by the GWAC.

This deep soil sampling plan will be implemented by South Yakima Conservation District (SYCD) and is summarized below.

1. Grower participation will be solicited by general mailings and outreach by SYCD and other participants of the GWAC.
2. Beginning in 2014, SYCD will distribute a unique identification number (UIN) to be retained by the grower only. The UIN will be translated into a bar code that will be used by the grower to identify their survey, the field and soil samples.
 - a. The Deep Soil Sampling Program Questionnaire will include information **specific to an individual field** such as pertinent management information including cropping systems,

nitrogen sources and amounts, historical yields, irrigation practices and application methods (Attachment A).

3. Soil sampling and analysis will begin in Fall 2014:
 - a. After crop harvest but prior to nitrogen applications where possible.
 - b. Soil samples will be collected at 1-foot increments from 0 to a depth not exceeding 6 feet, or to the depth of refusal as basalt, gravel or caliche that define the limits of a shallower potential root zone.
 - c. The 0-1 foot sample will be analyzed for nitrate, ammonium and organic matter content.
 - d. Deeper soil samples will be analyzed for nitrate only.
 - e. Soil descriptions will be recorded in the field, and the NRCS Soil Series will be identified and documented.
4. Sampling and analysis will be performed by qualified firms contracted to SYCD. Funding to SYCD will be from the LYV GWMA budget.
5. SYCD will use results from soil sampling to identify risk of nitrate leaching posed by the various soil/cropping/irrigation systems.
6. Data will be available on the GWAC Web site and available at SYCD. Data will be identified using and Unique Identification Number (UIN) and kept confidential using bar codes supplied to the grower. Only the participating grower will be able to identify his/her sample(s).
7. The GWAC will retain technical data for analysis.

2.0 DEEP SOIL SAMPLING PROGRAM

2.1 PROJECT ADMINISTRATION

The program will be administered by SYCD under the direction of the GWAC and this plan. Attachment B contains contact information for key project personnel.

SYCD will perform the following tasks:

- Recruit growers for the sampling program with assistance from the GWAC and the Irrigated Agriculture Working Group (IAWG). Effort will be made to get as diversified participation as possible considering crop type and areal distribution.
- Distribute UIN and labels with bar codes for soil samples and grower surveys.
- Contract firms to collect and analyze soil samples.

- Maintain records of sampling and analysis results.
- Record sampling data, analytical results, and quality assurance/quality control (QA/QC) results in a computer database (database design provided by GWMA).
- Provide the county with data to be published on the county web site.
- Report to the GWAC.

2.2 SELECTION OF SAMPLING SITES

The goal in field selection will be to involve as many growers and field conditions as possible for the established budget.

2.2.1 Outreach to Growers

Grower participation will be solicited by general mailings and outreach by SYCD and others participating in the GWAC. Growers will be encouraged to propose fields for sampling by contacting SYCD. In preparation for sampling, outreach should begin during spring/summer 2014.

2.2.2 Sites Identified by Other GWAC Work Groups

Sites other than irrigated agricultural fields may be sampled using the methods of this plan. Such sites may be proposed by the RCIM (residential-commercial-industrial-municipal) or Livestock-CAFO work groups. For application to sites other than agricultural fields, the method should be reviewed and modified if necessary to conform to site conditions. For instance:

- The number of boreholes and the radius within which boreholes are drilled may need to be reduced if a site with a small footprint is investigated.
- The depth of sampling should be coordinated around land cover, and water and waste management specific to the site.
- Analytes should be reviewed.

If the RCIM and Livestock-CAFO work groups propose sites for sampling, they will produce addenda to this plan indicating the sampling sites and necessary modifications to methods. Sites should be proposed prior to SYCD contracting for the work.

2.3 SAMPLING REQUIREMENTS

2.3.1 Expected Variability

The LYV GWAC understands that it would be cost prohibitive to characterize each field to a level of detail necessary to identify all the variability within a field or to accurately quantify field-level leaching estimates. Sampling sites will therefore be selected to measure effects of management practices for the predominant field conditions. The GWAC will evaluate the deep soil sampling program to determine whether the sample requirements and evaluation criteria should be modified during future sampling events.

Generic Variability: Generic conditions exist which create variability in all fields. Examples include field border effects, cultivation patterns, and position relative to an irrigation system. Figures 1 through 12 provide sampling schemes to be used for common field conditions that will be encountered by the program¹. These figures provide minimum setback distances to avoid field border and cultivation effects. They also suggest sampling locations and transect directions relative to irrigation systems so that known differences in irrigation uniformity can be avoided or incorporated appropriately.

Field Specific Variability: Factors that cause field specific variability include soil type, topography, and management practices. Selecting a sample site with relatively uniform conditions will be the responsibility of the grower. While resources are available to aid the grower, most growers have intimate knowledge of their fields and are best suited to select the locations of average field conditions.

2.3.2 Definitions

Based on the discussion above and for use in this document, the following definitions have been developed.

Sampling Setbacks: Those areas of the field that are automatically determined to be not representative of the average field condition and therefore inappropriate for sampling (Figures 1 – 12). Examples include field borders, first span of a center pivot, and known lap areas.

Sampling Zone: The field area available for sampling after the setbacks described in Figures 1 - 12 are taken into account.

Sampling Site: A sixty-foot diameter circle within the Sampling Zone where samples will be collected from at least four boreholes. The same sampling site will be used year-to-year if possible.

Borehole: A borehole where discrete soil samples are collected to contribute to the composite samples. Boreholes may be advanced by any method capable of collecting discrete samples of sufficient volume over 1-ft intervals – mechanized sampling devices are recommended.

Discrete Sample: A soil sample from a borehole, prior to compositing.

Composited One-foot Sample: The soil sample that will be analyzed to represent concentrations in a given one-foot depth increment within a sampling site. This soil will come from a composite mixture of discrete samples from the same depth from all boreholes.

2.3.3 Sampling Method Requirements

Samplers and laboratories will be contracted by SYCD to perform the field and laboratory work. SYCD will establish terms of the contract including minimum qualifications, and hardware and software to be employed. Samplers shall use GPS-based field location equipment coupled to soil survey maps for working with the grower on site selection and field orientation. The contracts will reference this plan as the basis for sampling and analysis requirements.

¹ Figures 3 and 4 apply to dryland sites which are not currently proposed for sampling. These figures are included for possible future reference.

Samples will be collected within a 60 foot diameter sampling site identified by the grower in conjunction with the sampler. The latitude and longitude at the center of the sampling site will be measured with a global positioning system device (GPS) provided by the sampler. The sampler will provide the coordinates to the grower for future reference. Latitude and longitude coordinates will be based on the datum WGS84 and measured/recorded to a precision of four decimal places (1×10^{-4} decimal degrees). Example: 46.3874, -120.1408. This level of precision results in the coordinate being rounded to +/- 12 ft East-West and +/- 18 ft North-South. The accuracy of the coordinates will depend on the type of GPS device & the alignment of satellites or the scale of the basemap. Care should be taken to make sure the GPS device is working properly and recording the locations as accurately as possible.

A minimum of four boreholes are required within each sampling site. A mechanized sampling tool (eg: Giddings, AMS, GeoProbe) is recommended that can collect soil from discrete one-foot increments to a depth of 6 feet below ground. The minimum nominal diameter of the standard cores shall be 2-inches; however, below a depth where a sampler is unable to advance a 2-inch core, as small as a 1-inch diameter core may be used. The pattern and location of the boreholes within the sample site will be conducted per the guidelines found in Figures 1 - 12. Portions of the sampling tools that contact soil must be cleaned between sample runs to minimize cross contamination of samples.

The soil from each borehole will be collected at one foot increments and placed temporarily in clean plastic buckets (one for each depth interval) in preparation for composite mixing. Buckets shall be cleaned at least between each sampling site. Each discrete soil sample will be described by the sampler in terms of consistency, moisture content, color, grain size, and other observations such as odor. The sampler will record soil descriptions on Boring Logs (Attachment C). In addition, the sampler will fill out one Soil Sample Field Form (Attachment D) for each site to document the soil sample compositing and lab-submittal process. The Boring Logs, Soil Sample Field Form, and Grower Survey Questionnaire will be returned to the SYCD by the sampler.

Boreholes will be advanced to a maximum depth of 6 feet or until refusal, whichever is shallower. If boreholes terminate at different depths, composite samples will be created by compositing available discrete samples (which may number less than four). During boring and soil collection, care should be taken to avoid mixing the soil from discrete one-foot depth increments with soils from shallower or deeper depths.

After all boreholes have been dug and the soil from each individual depth increment has been placed in the plastic buckets, the soil will be mixed thoroughly in the buckets to form a composite one-foot sample. After compositing, a portion of soil in each quadrant of the bucket will be transferred to a lab-prepared sample container. Tools used to mix and transfer samples must be clean to minimize cross contamination of samples.

Boreholes will be backfilled by the sampler using tamped native soil to prevent creation of a vertical conduit.

2.3.4 Safety and Liability

Because of the proposed sample depths, samplers should use mechanized sampling equipment, which is inherently dangerous. In addition to physical hazards of the equipment itself, there is the potential to intersect power and other utility lines that may lie above or beneath a sampling site.

The sampler must call the utility notification center (information at <http://www.callbeforeyoudig.org>) and leave sufficient time for their response prior to field work. The grower must identify and record the location of utilities on private land during orientation with SYCD and flag/stake any underground utilities in the field that are within 200 ft of the agreed sample site.

Responsibility for personnel safety will reside with the sampling company.

The GWMA project will repair damage to property of the cooperating grower caused by field sampling except for that caused by the negligence of the sampler. Property damage caused by negligence on the part of the sampler will be repaired by the sampler.

2.3.5 Sampling Schedule

Each sampling site will be sampled for baseline purposes once, unless additional soil sampling is requested based on review of data by GWMA workgroups.

When possible, samples will be collected after crop harvest but prior to any nitrogen amendments. Recent crop, nutrient, and irrigation actions will be recorded by SYCD.

2.3.6 Handling and Custody

A Soil Sample Field Form (Attachment D) will be filled-out by the grower/sampler for each field to be sampled. The UIN will be distributed by the SYCD. The UIN will be used to identify each composited soil sample. Grower identification information will not be included on the Deep Soil Sampling Questionnaire, Soil Sample Field Form, Boring Logs, or sample container labels.

Soil samples will be delivered by contracted samplers to contracted commercial laboratories. For delivery to the lab, samples shall be placed in a cooler with reusable ice substitutes or with ice. If ice is used, sample containers must be placed inside a waterproof bag to prevent contact with melting ice. At no time shall the sampler store samples for more than 48 hours. Samplers may dry samples using methods acceptable to the laboratories and consistent with analytical methods. If the laboratory cannot analyze the sample within 48 hours of sample collection the laboratory must preserve the samples by methods acceptable for the analytical method and standard practice.

The sampler and lab must complete a Chain of Custody form for each batch of samples delivered. The COC must contain the Date, Time, Sampler Name, Bar Code for the UIN, and Sample Depth for each sample submitted. The sampler relinquishing the samples and the laboratory receiving the samples must sign the COC. The “owner” and “client” information on the COC shall be the SYCD, not the grower.

2.4 ANALYTICAL METHODS

The following analytes are required for this program.

- nitrate-nitrogen
- ammonium-nitrogen
- organic matter

The sample from the upper one-foot will be analyzed for all three analytes. Samples below the first foot will be analyzed solely for nitrate-nitrogen. The following subsections specify the laboratory analysis methods.

SYCD will contract with one laboratory to perform the work. Only laboratories that participate in the North American Laboratory Proficiency Testing Program (NAPT) and NAPT's Proficiency Assessment Program (PAP) for the methods listed in this plan will be eligible.

The laboratory shall be instructed to report nitrate concentrations in parts per million (ppm) or milligrams per kilogram (mg/kg) and as pounds per acre (lbs/acre) for each one-foot layer. All reporting values shall be on a dry weight basis. Laboratories shall report assumptions used in conversion from ppm (mg/Kg) to lbs/acre.

The analytical lab report (including QA/QC results) will be submitted to SYCD within three weeks from the date of the analysis. The lab report must indicate the date and time of the analysis for each sample.

2.4.1 Nitrate-Nitrogen

Either of the two analytical methods below are acceptable for measuring nitrate-nitrogen.

Method: Cadmium Reduction

Reporting limit: 1 mg/Kg or lower

Method Reference: Cadmium Reduction Method, S-3.10, Western States Laboratory Proficiency Testing Program: Soil and Plant Analytical Methods, 3rd Edition, 2005, From: Plant, Soil, and Water Reference Methods for the Western Region. 1994, R.G: Gavlak, D.A. Horneck, and R.O. Miller, WREP 125.

Method: Automated Cadmium Reduction (with extraction step added for application to soil samples)

Reporting Limit: 1 mg/Kg or lower

Method Reference: 4500-NO₃. F, 1987. Annual Book of ASTM Standards, Vol. 11.01. American Soc. Testing & Materials, Philadelphia, Pa.

2.4.2 Ammonium-Nitrogen

Method: KCL Extraction / Exchangeable ammonium

Reporting Limit: 1 mg/Kg or lower

Method Reference: KCL Extraction / Exchangeable ammonium Method; S-3.50; Western States Laboratory Proficiency Testing Program: Soil and Plant Analytical Methods, 3rd Edition, 2005, From: Plant, Soil, and Water Reference Methods for the Western Region. 1994, R.G: Gavlak, D.A. Horneck, and R.O. Miller, WREP 125.

2.4.3 Organic Matter

Method: Walkley-Black Titration

Reporting Limit: 0.1 percent

Method Reference: Walkley-Black ; S-9.10; Western States Laboratory Proficiency Testing Program: Soil and Plant Analytical Methods, 3rd Edition, 2005, From: Plant, Soil, and Water Reference Methods for the Western Region. 1994, R.G: Gavlak, D.A. Horneck, and R.O. Miller, WREP 125.

2.5 QUALITY CONTROL AND DATA QUALITY OBJECTIVES

Adherence to this plan will maintain quality control for the project. Quality assurance samples shall be analyzed and the results reported to SYCD. The SYCD contract with samplers and laboratories will allow for the GWMA project to discuss results with the samplers and laboratories to determine the cause of problems and arrange for changes in procedure to achieve the data quality objectives.

Laboratories shall perform laboratory blank measurements, calibration measurements, method detection limit determinations, duplicate analyses and performance evaluation samples according to standard laboratory and method-specific procedures. In addition, SYCD will submit performance evaluation samples to the labs. Quality assurance data must be reported with each analytical report submitted to SYCD.

2.5.1 Quality Control Requirements

2.5.1.1 Instrument and Equipment Testing, Inspection, Calibration, and Maintenance

The participating laboratories will follow their standard operating procedures for maintenance and calibration of instruments or systems used for this project. The frequency of calibration will also be consistent with their standard operating procedures.

2.5.1.2 Inspection/Acceptance of Supplies and Consumables

Soil sampling tools shall be supplied by the participating samplers and they will assure the tools are clean and in proper operating condition. Laboratories will inspect and accept supplies per their standard operating procedures. Samplers will obtain sampling containers from the participating laboratories. Samplers shall only accept new (not used) sample containers that are clean.

2.5.1.3 Data to Support Repeat Sampling

To promote consistency and avoid confusion where sites are sampled repeatedly, SYCD and the grower shall refer to the prior Soil Sample Field Form and the latitude and longitude of the sampling site retained by the grower so that the same sites can be revisited. In repeat sampling, growers shall reuse previous UIN and any remaining bar-code labels (grower/sampler can hand-write the UIN on forms and samples as necessary). Growers shall fill out a new Deep Soil Sampling Questionnaire to reflect field conditions since the last sample round. For data analysis, SYCD shall use the combination of common UIN but different sample dates to match sites that are resampled.

2.5.1.4 Specialized training

Labs and sampling firms are responsible for providing personnel who are qualified to perform the work.

2.5.2 Quality Control Samples and Data Quality Objectives

Requirements to assess accuracy, representativeness, comparability and completeness are summarized below. Data Quality Objectives (DQOs) have been established to help the GWMA project meet its overall objectives. Project DQOs may be revised by GWAC approval in the future.

2.5.2.1 Accuracy

Accuracy is a measure of confidence that describes how close a measurement is to its "true" value. In this program, accuracy will be measured by analysis of performance evaluation (PE) samples provided by a third party and by evaluation of internal lab control samples where such samples are standard to the lab practice.

PE samples (soil with known nitrate concentration) will be obtained by SYCD and submitted blind to prospective laboratories prior to contracting with SYCD. These samples will be obtained from a source used by the North American Laboratory Proficiency Testing program. Two concentrations of PE samples will be used and will represent medium (10-15 mg/kg) and high (>50 mg/kg) soil nitrate values. In addition, SYCD will provide the contracted laboratory blind samples from the medium and high PE samples at least twice during the project time period each year. The RPD between the known value and the reported value from each laboratory will be calculated. A RPD of 20% will be acceptable for this project. If the RPD for individual laboratories regularly falls outside this range, the GMWA project will take corrective action which may include denying the laboratory further participation in the GWMA program.

2.5.2.2 Representativeness

Representativeness is the degree to which data from the project accurately represent a particular characteristic of the environmental matrix which is being tested. Representativeness of samples is ensured by adherence to the field sampling protocols and standard laboratory protocols. The design of the sampling scheme and number of samples should provide a representativeness of the soil matrix being sampled.

2.5.2.3 Comparability

Comparability is the degree to which data can be compared directly to similar studies. Using standardized sampling, analytical methods and units of reporting with comparable sensitivity helps ensure comparability. The GWMA project is using sampling and analysis methods that are currently being employed by the agricultural industry for nutrient management decisions. The Columbia Basin Deep Soil Sampling Program was conducted using similar procedures.

2.5.2.4 Completeness

Completeness is the percentage of valid results obtained compared to the total number of samples taken for a parameter. A complete or valid result will include full completion of the Deep Soil Sampling Questionnaire, Soil Sample Field Form, Boring Logs, and a laboratory analysis report, all linked through the UIN. Percent completeness may be calculated using the following formula. A DQO of 80% is established for this parameter.

$$\% \text{ Completeness} = \frac{\# \text{ of valid results}}{\# \text{ of samples taken}} \times 100$$

2.6 INFORMATION MANAGEMENT

2.6.1 Soil Sampling

Documentation of field and laboratory work for each soil sampling site will consist of submittal of the following documents to SYCD:

- Completed Deep Soil Sampling Questionnaire
- Completed Soil Sample Field Form
- Completed Boring Logs
- A completed Chain of Custody Form
- A copy of the analytical results, including QA/QC results

Forms shall be submitted to the SYCD who will retain the minimum records necessary for technical analysis of the data, documentation to facilitate repeat sampling, and possible audit of financial data.

2.6.2 Computerization of Technical Information

SYCD will enter sample and analytical data into a computer database. The GWMA project will provide the SYCD the database entry form. Computerized data will include technical data necessary for interpretation of the results by the GWMA project. Such data will include sample ID; sampling date; nitrate, ammonium, and OM concentrations; and depth; field information including nitrogen sources and amounts, historical yields, and irrigation practices. The sampling and analytical data will be linked to the soil type, nitrate leaching potential (per NRCS), irrigation type, crop, and other data provided by the grower and recorded by SYCD. SYCD will provide the GWMA the computer database within 90 days of the close of the sampling season (eg: by mid August assuming a mid-May end of sampling season).

SYCD will provide the county with data and copies of the documents listed in section 2.6.1 above identified only by the UIN.

The county will publish data on the LYV GWMA website. Growers will access data from the website or from SYCD.

3.0 TARGETED SAMPLING

Analysis of initial Deep Soil Sampling data collected in 2014 will likely reveal uneven coverage of geographic areas, soil types, crop types, irrigation types, and nitrogen sources. Uneven coverage is expected and may be acceptable; however, extreme bias or uneven coverage could jeopardize fulfillment of GWMA project goals. The GWMA project will analyze distribution of the 2014 data across the field conditions, and identify possible unacceptable bias or gaps in coverage. If unacceptable bias or gaps are present, the GWMA project will reach-out to growers in uncovered areas and

request participation in the deep soil sampling program. Outreach should occur in winter of 2014-15, and sampling to fill data gaps will occur in early 2015.

Targeted sampling may also include sampling of the following sites not accessible through the 2014 program. Note these locations may involve locations that are not irrigated agricultural fields, and would be identified through work of appropriate GWMA subcommittees (eg: livestock-CAFO or residential-commercial-industrial-municipal).

- control sites without intentional nitrogen application
- industrial and commercial sites managing nitrogen fertilizers or wastes
- point sources of possible nitrogen contamination
- private fields in close proximity to wells

FIGURES

Figure 1. Sampling scheme for center pivot irrigation system.

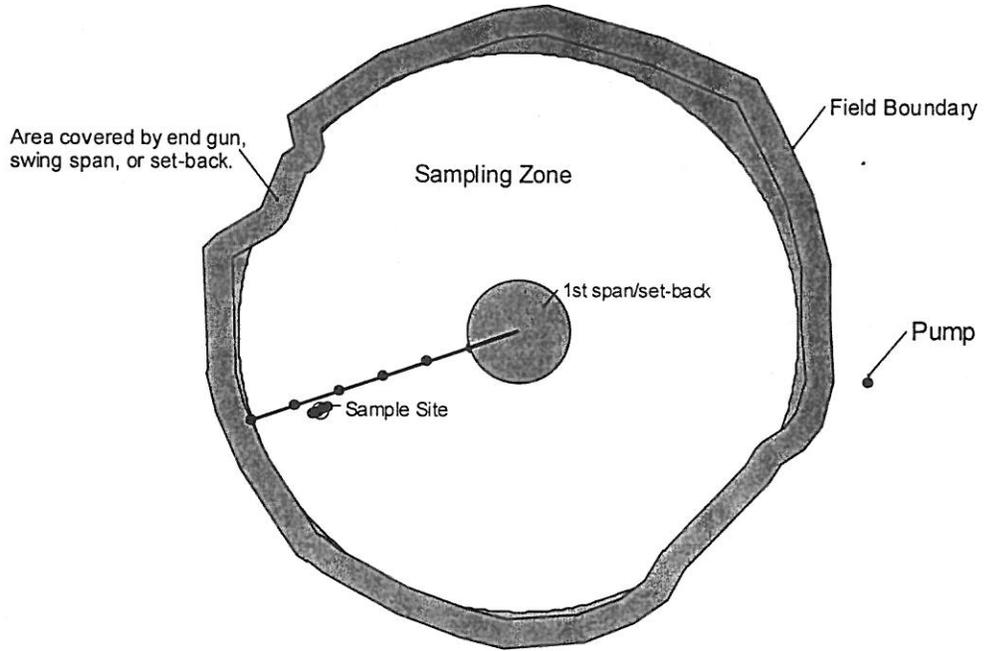


Figure 2. Sample site detail for center pivot irrigation.

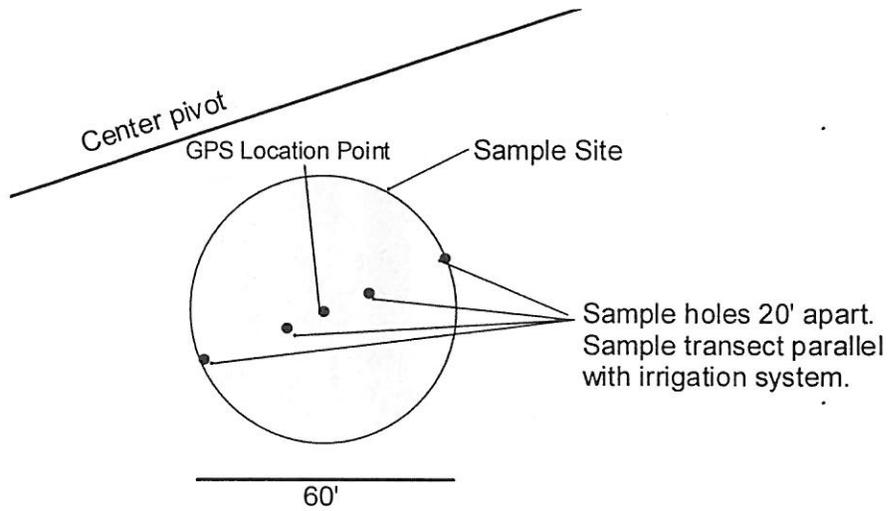


Figure 3. Sampling scheme for dryland fields.

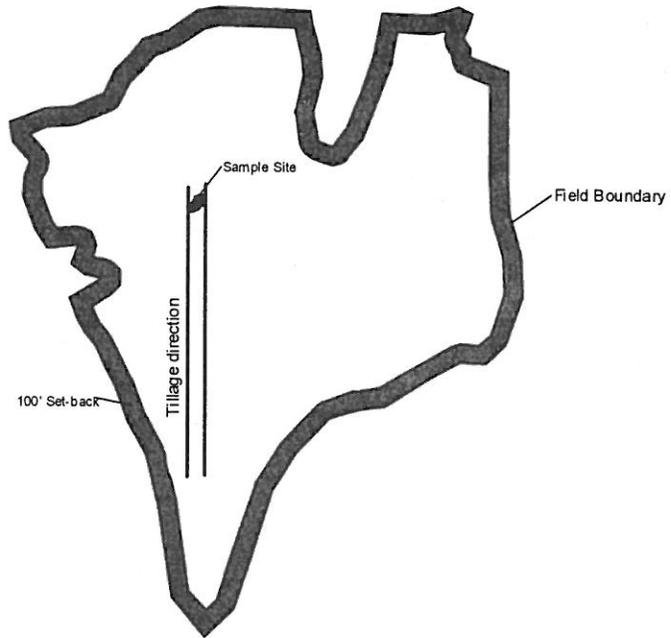


Figure 4. Sample site detail for dryland fields.

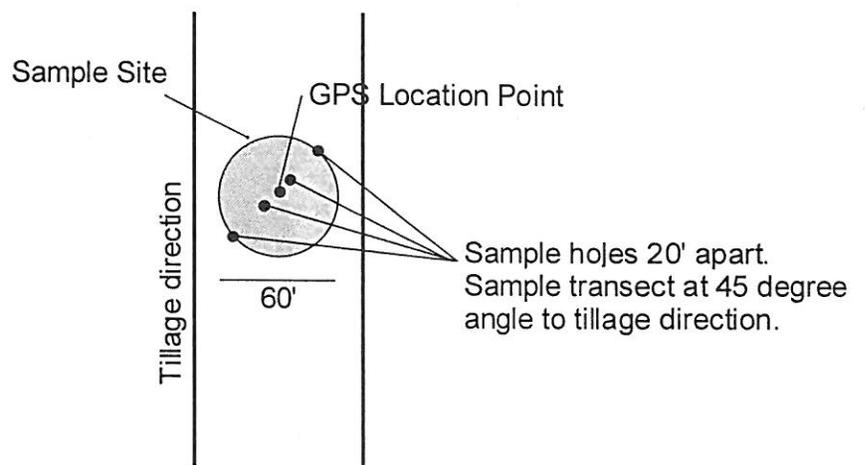


Figure 5. Sampling scheme for handline, wheelline, or solid set (row crop) irrigation systems.

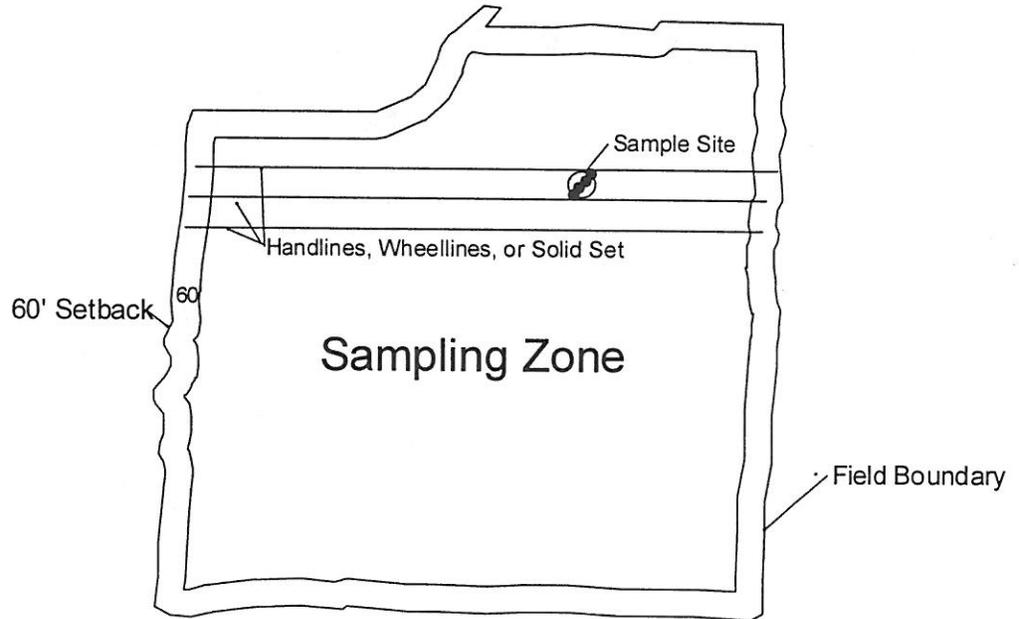


Figure 6. Sample site detail for handline, wheelline, or solid set (row crop) irrigation systems.

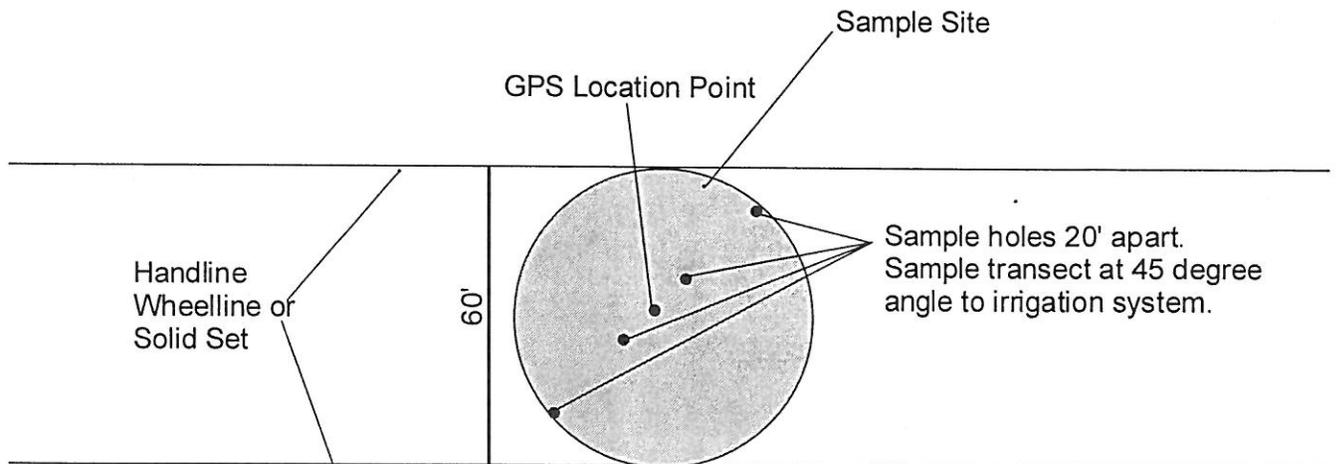


Figure 7. Sampling scheme for rill irrigation systems.

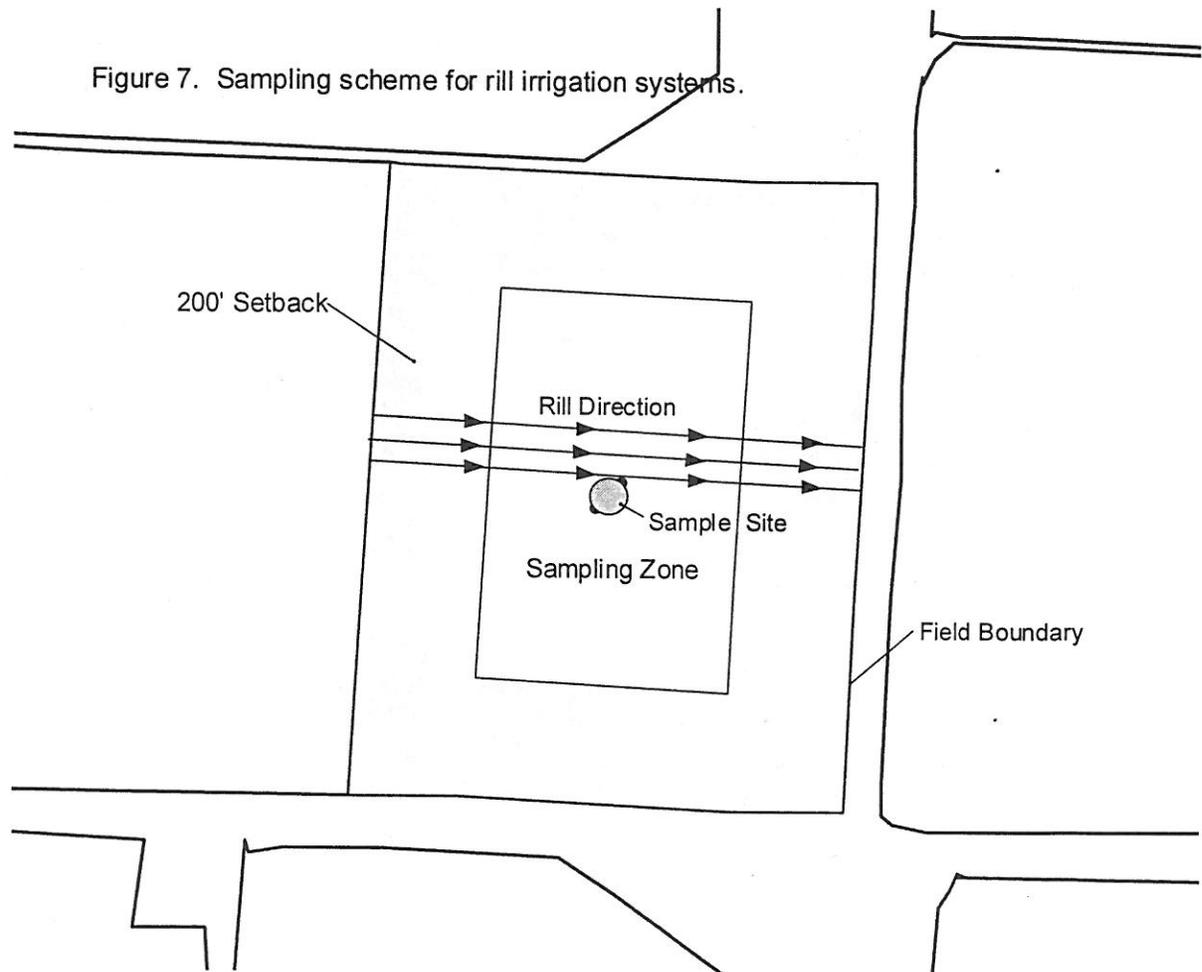


Figure 8. Sample site detail for rill irrigation systems.

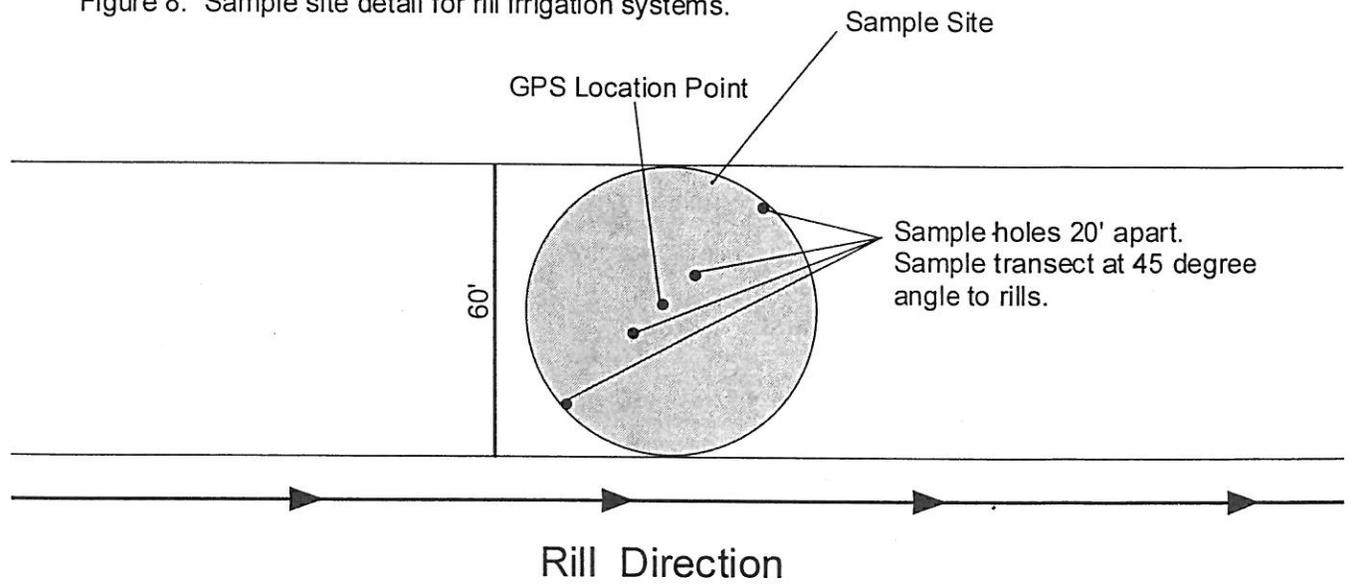


Figure 9. Sampling scheme for solid set or micro-spray (orchards & vineyards) irrigation systems.

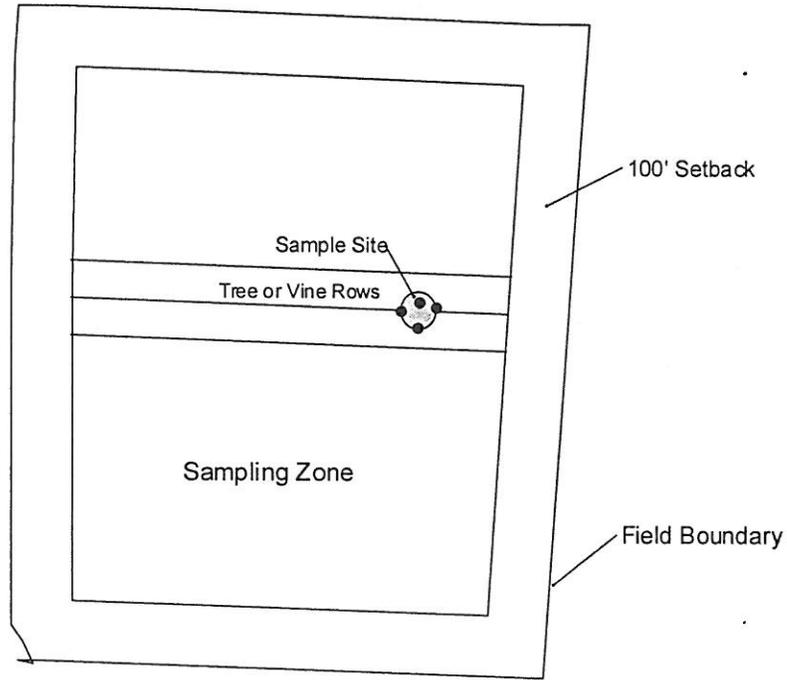


Figure 10. Sample site detail for orchard and vineyards with solid-set or drip irrigation systems.

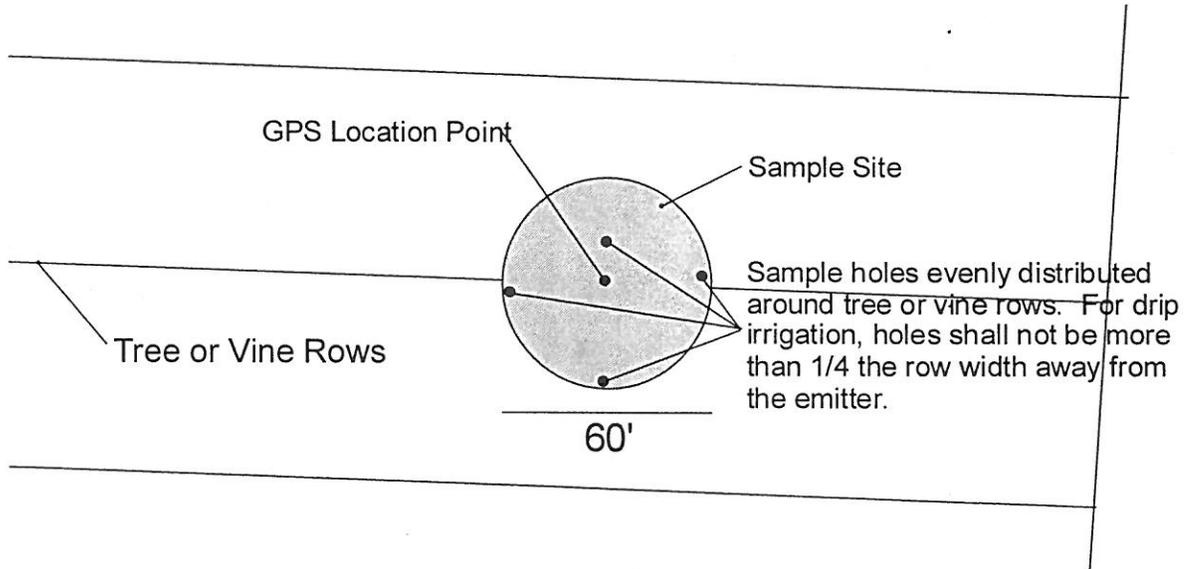


Figure 11. Sampling scheme for linear move irrigation systems.

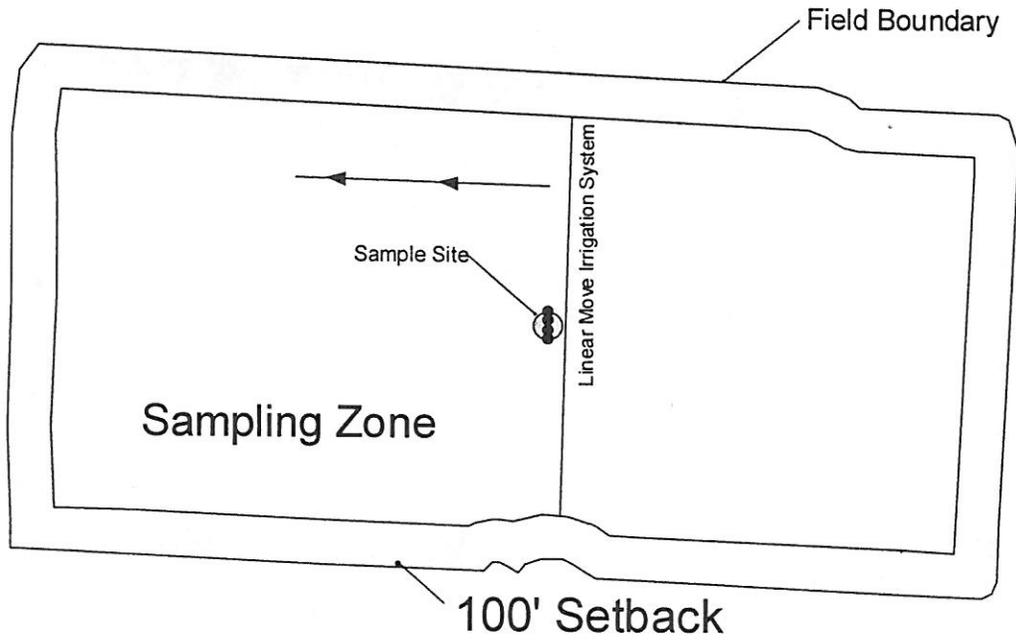
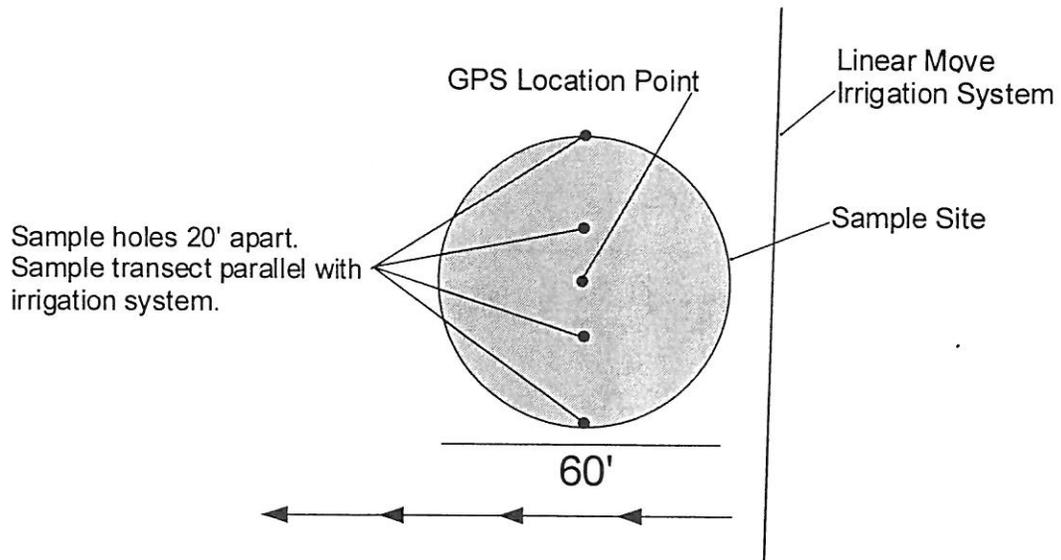


Figure 12. Sample site detail for linear move irrigation systems.



ATTACHMENT A
DEEP SOIL SAMPLING PROGRAM QUESTIONNAIRE

Deep Soil Sampling Program Questionnaire

General:

As you may know, the aquifer in the Lower Yakima Valley has been shown to have groundwater nitrate concerns. Nitrogen that has migrated below the root zone is useless to crops and can be damaging to water quality. The Lower Yakima Valley Groundwater Advisory Committee (GWAC) designed this grower survey to help everyone better understand current production methods and provide guidance to improve farming practices to assist in improved farming practices. The correlation of the questionnaire with the Deep Soil Sampling Program is an attempt to understand the relationships between the amount and form of nitrogen applied, the application method and timing, the irrigation method, the amount of nitrogen required for plant growth based on cropping patterns, and the quantity of nitrogen that has migrated below the root zone. Participation will be anonymously structured as explained below.

The LOWER YAKIMA VALLEY Groundwater Advisory Committee (GWAC) is encouraging broad producer participation in the Deep Soil Sampling Program – at no cost to the grower. Nitrogen is an expensive input and once it migrates below the root zone it becomes an expensive loss. The results of your soil samples can help guide your input decisions and potentially reduce your nutrient expenses. A grower survey has been designed to better understand current production methods and assist in improved farming practices, where they may be needed to reduce nitrates in groundwater. For those producers who, for whatever reason chose not to participate in the Deep Soil Sampling Program, the GWAC would still encourage participation through completion of the landowner survey to help us understand current production practices. This questionnaire is intended for either growers who participate in the soil sampling project and those growers who choose not to participate.

We are thanking you in advance for agreeing to participate in the Lower Yakima Valley Groundwater Management Area Deep Soil Sampling Program and for completing the questionnaire. As mentioned above, samples will be taken on your property and analyzed at no cost to you, if you participate in the soil sampling program. We are also interested in knowing your agricultural practices such as crops grown, plant nutrients applied, irrigation practices, and soil type. While information gathered in the study will be summarized, your specific data will be confidential. Site specific information asked for on the questionnaire will not be public information. It will be summarized and used in a collective manner to help describe farming operations in the resulting report.

We have developed a procedure to protect your identity and the location of the soil sample locations. This protects your identity in your participation on the questionnaire as well. You are welcome to share that information with the South Yakima Conservation District or anyone else, but are under no obligation to do so.

Please keep the number associated with the attached bar code sheet. The bar code is the same number. It should be filed in a safe location so that you can refer to it to review your results of the soil sampling. With this number, you will be the only person that can identify your soil samples. It is not necessary to include all of the fields on your farm. You can select as many fields to include in the study as you feel comfortable with and may be able to add others later. If you decide not to

Deep Soil Sampling Program Questionnaire

include all fields in the study, be sure and convey that information to the person collecting the samples when they arrive.

Place one bar code sticker on the questionnaire and return it in the envelope addressed to the South Yakima Conservation District and mail it. Do not include your return address. When the samples are collected, give the bar codes to the sampler who will attach them to the sample containers.

When all of the samples have been collected, analyzed, and tabulated they will be posted on a website or published in a format suitable for public access. The results from your farm will be identified by the number only you will know.

Participation in the Deep Soil Sampling Program can benefit you economically, as the analytical results will help determine whether or not expensive nitrogen is being applied in excess of what your crop can utilize.

Thanks for your participation.

Note to SYCD: Among other specifications for the samplers, the successful sampler must have an application on a portable device that will pull up the soil information from the NRCS site.

Deep Soil Sampling Program Questionnaire

WORKSHEET FOR IRRIGATED CROPLAND

Bar Code (Place Bar Code Here)

Date: _____

Field History

Years Owned/Farmed _____ Soil Type (if know): _____

Currently Soil Testing ___ Yes ___ No If yes, how often? _____

Number of Acres: _____

Tillage Practices For Crop Cycle

Current Crop (2014) _____ Crop condition: ___ Poor ___ Fair ___ Good
Tons/Bushels/Bins/Acre _____ actual or planned (circle one)

Cropping History (Include Double Crossing)

Crop Rotation:

2011 Crop 1 _____ Tons/Bushels/Bins/Acre _____; Crop 2 _____ Tons/Bushels/Bins/Acre _____

2012 Crop 1 _____ Tons/Bushels/Bins/Acre _____; Crop 2 _____ Tons/Bushels/Bins/Acre _____

2013 Crop 1 _____ Tons/Bushels/Bins/Acre _____; Crop 2 _____ Tons/Bushels/Bins/Acre _____

2014 Crop 1 _____ Tons/Bushels/Bins/Acre _____; Crop 2 _____ Tons/Bushels/Bins/Acre _____

Current method of scheduling irrigation:

___ ET; ___ soil moisture sensors; ___ Routine _____ hr. sets; Weather Stations _____

Current Irrigation System: **Years of use on crop?** _____

___ Flood Irrigation

___ Rill Irrigation

___ Solid Set above canopy - ___ Impact Sprinklers, ___ Micro spray ___ Rotators

___ Solid Set below canopy - ___ Impact Sprinklers, ___ Micro spray ___ Rotators

___ Wheel lines ___ Impact Sprinklers ___ Rotators

___ Hand lines ___ Impact Sprinklers ___ Rotators

___ Linear move ___ Impact Sprinklers, ___ Micro spray ___ Rotators

___ Drip ___ tube, ___ tape, ___ bury line ___ above ground line

___ Pivot ___ Impact Sprinklers, ___ Micro spray ___ Rotators

Deep Soil Sampling Program Questionnaire

___ Pod line ___ Impact Sprinklers ___ Rotators

___ Other: _____

Previous Irrigation System: **Years of use on crop?** _____

___ Flood Irrigation

___ Rill Irrigation

___ Solid Set above canopy - ___ Impact Sprinklers, ___ Micro spray ___ Rotators

___ Solid Set below canopy - ___ Impact Sprinklers, ___ Micro spray ___ Rotators

___ Wheel lines ___ Impact Sprinklers ___ Rotators

___ Hand lines ___ Impact Sprinklers ___ Rotators

___ Linear move ___ Impact Sprinklers, ___ Micro spray ___ Rotators

___ Drip ___ tube, ___ tape, ___ bury line ___ above ground line

___ Pivot ___ Impact Sprinklers, ___ Micro spray ___ Rotators

___ Pod line ___ Impact Sprinklers ___ Rotators

___ Other: _____

Nitrogen applications

Manure - Liquid

Year	Gallons/Acre applied	#N/1000 gal	How applied	Hours to incorporation	notes
2014					
2013					
2012					
2011					

Manure - Solid

Year	Tons/Acre applied	#N/ton	How applied	Hours to incorporation	notes
2014					
2013					
2012					
2011					

Commercial Fertilizer

Year	Material type?	#N/Acre applied	How applied	Hours to incorporation	notes
2014					
2013					

Deep Soil Sampling Program Questionnaire

2012					
2011					

Biosolids

Year	Tons/Acre applied	#N/ton	How applied	Hours to incorporation	notes
2014					
2013					
2012					
2011					

Compost

Year	Tons/Acre applied	#N/ton	How applied	Hours to incorporation	notes
2014					
2013					
2012					
2011					

Other

Year	Tons applied	#/ton	How applied	Hours to incorporation	notes
2014					
2013					
2012					
2011					

Please provide additional information if appropriate such as split applications, starter, side dress, etc. _____

Comments: _____

ATTACHMENT B KEY PERSONNEL

Attachment B - Key Personnel

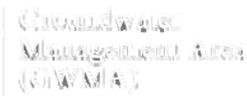
Deep Soil Sampling

Lower Yakima Valley Groundwater Management Area

Deep Soil Sampling Program Role	Person
Deep Soil Sampling Project Manager	To be determined
SYCD Project Administrator	Laurie Crowe, SYCD, (509) 829-9025
Groundwater Advisory Committee Alternate Chair	Vern Redifer, Yakima County, (509) 574-2300
Irrigated Agriculture Committee Chair	Jim Trull, SVID, (509) 837-8611
Livestock / Confined Animal Feeding Operation Committee Chair	Charlie McKinney, Dept. Ecology, 509-457-7107
Data Committee Chair	Kirk Cook, WSDA, (360) 902-1936
Education and Public Outreach Committee Chair	Lisa Freund, Yakima County, (509) 574-2300

ATTACHMENT C BORING LOG

Soil Boring Log



Return this form, filled out, to South Yakima Conservation District
 PO Box 1766 (or 200 Chenye Rd), Zillah, WA 98953
 Fax: (509) 829-9027

Bar Code (Place Bar Code Here)

Boring Number: _____

Boring Date: _____

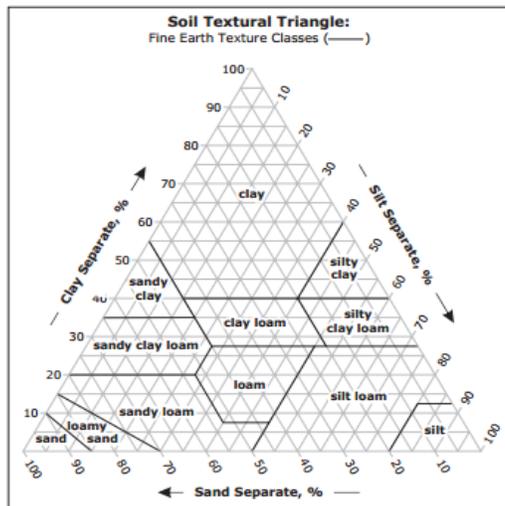
Boring Logged by: _____

Boring and Sampling Device (example: AMS 9100 Ag Probe with 2-inch tube sampler) _____

NRCS Soil Series (soil type) _____

Describe each soil sample.

Depth in ft	Munsell color	Consistence	Moisture	Texture	Other
0-1					
1-2					
2-3					
3-4					
4-5					
5-6					
6-7					
7-8					



TEXTURE MODIFIERS - Conventions for using "Rock Fragment Texture Modifiers" and for using textural adjectives that convey the "% volume" ranges for **Rock Fragments - Size and Quantity**.

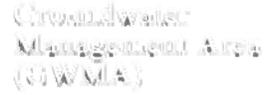
Fragment Content % by Volume	Rock Fragment Modifier Usage
< 15	No texture adjective is used (noun only; e.g., loam).
15 to < 35	Use adjective for appropriate size; e.g., gravelly.
35 to < 60	Use "very" with the appropriate size adjective; e.g., very gravelly.
60 to < 90	Use "extremely" with the appropriate size adjective; e.g., extremely gravelly.

Moisture options: D=dry
 M=moist
 Dp=damp
 W=wet

Consistence options:
 L=loose, S=soft, SH=slightly hard, HA=hard, EH=extremely hard, FR=friable, FI=firm; VFI=very firm; C=cemented.
 See Field Book for Describing and Sampling Soils, NRCS, August 2011.

ATTACHMENT D
SOIL SAMPLE FIELD FORM

Soil Sample Field Form



Return this form, filled out, to South Yakima Conservation District
 PO Box 1766 (or 200 Chenye Rd), Zillah, WA 98953
 Fax: (509) 829-9027

Bar Code (Place Bar Code Here)

Sample Collection Date: _____ Sampled by: _____

Check depths sampled in each borehole, and samples submitted to lab:

Depth in ft	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Composite Submitted
0-1					
1-2					
2-3					
3-4					
4-5					
5-6					
6-7					
7-8					

Sampling Site Sketch:
 Draw sampling site and borings in relation to irrigation system and other features.
 Provide GPS coordinates to owner (to 0.0001 decimal degree precision).



North